Complete Summary

GUIDELINE TITLE

ACR Appropriateness Criteria™ for cerebrovascular disease.

BIBLIOGRAPHIC SOURCE(S)

Masaryk T, Drayer BP, Anderson RE, Braffman B, Davis PC, Deck MD, Hasso AN, Johnson BA, Pomeranz SJ, Seidenwurm D, Tanenbaum L, Masdeu JC. Cerebrovascular disease. American College of Radiology. ACR Appropriateness Criteria. Radiology 2000 Jun;215(Suppl):415-35. [60 references]

COMPLETE SUMMARY CONTENT

SCOPE

DISEASE/CONDITION(S)

Cerebrovascular disease

GUIDELINE CATEGORY

Diagnosis

CLINICAL SPECIALTY

Emergency Medicine
Family Practice
Internal Medicine
Neurological Surgery
Neurology
Radiology

INTENDED USERS

Health Plans
Hospitals
Managed Care Organizations
Physicians
Utilization Management

GUIDELINE OBJECTIVE(S)

To evaluate the appropriateness of initial radiologic examinations for cerebrovascular disease

TARGET POPULATION

Patients with cerebrovascular disease

INTERVENTIONS AND PRACTICES CONSIDERED

1. Ultrasound
2. Intra-arterial angiography
3. Magnetic resonance angiography
4. Magnetic resonance plain:
    - spin-echo
    - gradient-echo
    - fluid-attenuated inversion recovery
    - and/or diffusion
5. Functional magnetic resonance imaging:
    - BOLD
    - spectroscopy
    - and/or perfusion
6. Magnetic resonance with contrast
7. Computed tomography angiography
8. Computed tomography:
    - perfusion (xenon, iodine)
    - plain
    - with contrast
9. Single-photon emission computed tomography
10. Position emission tomography

MAJOR OUTCOMES CONSIDERED

Utility of radiologic examinations in differential diagnosis

METHODOLOGY

METHODS USED TO COLLECT/SELECT EVIDENCE

Searches of Electronic Databases

DESCRIPTION OF METHODS USED TO COLLECT/SELECT THE EVIDENCE

The guideline developer performed literature searches of recent peer-reviewed medical journals, primarily using the National Library of Medicine's MEDLINE database. The developer identified and collected the major applicable articles.

NUMBER OF SOURCE DOCUMENTS

The total number of source documents identified as the result of the literature search is not known.

METHODS USED TO ASSESS THE QUALITY AND STRENGTH OF THE EVIDENCE

Expert Consensus (Delphi Method)
Weighting According to a Rating Scheme (Scheme Not Given)

RATING SCHEME FOR THE STRENGTH OF THE EVIDENCE

Not applicable

METHODS USED TO ANALYZE THE EVIDENCE

Systematic Review with Evidence Tables

DESCRIPTION OF THE METHODS USED TO ANALYZE THE EVIDENCE

One or two topic leaders within a panel assume the responsibility of developing an evidence table for each clinical condition, based on analysis of the current literature. These tables serve as a basis for developing a narrative specific to each clinical condition.

METHODS USED TO FORMULATE THE RECOMMENDATIONS

Expert Consensus (Delphi)

DESCRIPTION OF METHODS USED TO FORMULATE THE RECOMMENDATIONS

Since data available from existing scientific studies are usually insufficient for meta-analysis, broad-based consensus techniques are needed to reach agreement in the formulation of the Appropriateness Criteria. Serial surveys are conducted by distributing questionnaires to consolidate expert opinions within each panel. These questionnaires are distributed to the participants along with the evidence table and narrative as developed by the topic leader(s). Questionnaires are completed by the participants in their own professional setting without influence of the other members. Voting is conducted using a scoring system from 1-9, indicating the least to the most appropriate imaging examination or therapeutic procedure. The survey results are collected, tabulated in anonymous fashion, and redistributed after each round. A maximum of three rounds is conducted and opinions are unified to the highest degree possible. Eighty (80) percent agreement is considered a consensus. If consensus cannot be reached by this method, the panel is convened and group consensus techniques are utilized. The strengths and

weaknesses of each test or procedure are discussed and consensus reached whenever possible.

RATING SCHEME FOR THE STRENGTH OF THE RECOMMENDATIONS

Not applicable

COST ANALYSIS

A formal cost analysis was not performed and published cost analyses were not reviewed.

METHOD OF GUIDELINE VALIDATION

Internal Peer Review

DESCRIPTION OF METHOD OF GUIDELINE VALIDATION

Criteria developed by the Expert Panels are reviewed by the American College of Radiology (ACR) Committee on Appropriateness Criteria and the Chair of the ACR Board of Chancellors.

RECOMMENDATIONS

MAJOR RECOMMENDATIONS

ACR Appropriateness Criteria™

Assumptions

All patient scenarios should be addressed as though the patients had been referred for imaging following a history and physical examination including neurologic, vascular, and ophthalmoscopic exams.

Clinical Condition: Asymptomatic Cerebrovascular Disease*

Variant 1: Structural lesion on physical exam (bruit) and/or risk factors.

Radiologic Exam Procedure	Appropriateness Rating	Comments
Ultrasound	8	
Intra-arterial angiography	4	If magnetic resonance angiography, computed tomography angiography, or ultrasound positive.
Magnetic resonance		

Magnetic resonance angiography	6	
Magnetic resonance plain (spin-echo, gradient-echo, fluid-attenuated inversion recovery, and/or diffusion)	6	
Functional magnetic resonance imaging (BOLD, spectroscopy, and/or perfusion)	4	If magnetic resonance angiography, computed tomography angiography, or ultrasound positive--potential value.
Magnetic resonance with contrast	2	
Computed tomography		
Computed tomography angiography	5	
Computed tomography perfusion (xenon, iodine)	4	If magnetic resonance angiography, computed tomography angiography, or ultrasound positive--potential value.
Computed tomography plain	2	
Computed tomography with contrast	2	
Nuclear medicine		
Single-photon emission computed tomography	4	If magnetic resonance angiography , computed tomography angiography, or ultrasound positive--potential value.
Positron emission tomography	2	
Appropriateness Criteria Scale 1 2 3 4 5 6 7 8 9 1=Least appropriate 9=Most appropriate		

* The choice of magnetic resonance angiography versus computed tomography angiography is dependent on local equipment and expertise.

The choice of single-photon emission computed tomography versus computed tomography versus magnetic resonance imaging for determining perfusion is dependent on local equipment and expertise. Major advances in potential applications are expected.

Clinical Condition: Transient Ischemic Attack*

Variant 2: Carotid territory transient ischemic attack, initial screening survey.

Radiologic Exam Procedure	Appropriateness Rating	Comments
Ultrasound	8	
Intra-arterial angiography	6	If magnetic resonance angiography, computed tomography angiography, or ultrasound positive.
Magnetic resonance		
Magnetic resonance plain (spin-echo, gradient-echo, fluid-attenuated inversion recovery, and/or diffusion)	8	
Magnetic resonance angiography	8	
Magnetic resonance with contrast	4	
Functional magnetic resonance imaging (BOLD, spectroscopy, and/or perfusion)	4	If magnetic resonance angiography, computed tomography angiography, or ultrasound positive--potential value.
Computed tomography		
Computed tomography angiography	6	
Computed tomography plain	4	If magnetic resonance unavailable.
Computed tomography perfusion (xenon, iodine)	4	If magnetic resonance angiography, computed tomography angiography, or ultrasound positive--potential value.
Computed tomography with contrast	2	
Nuclear medicine		
Single-photon emission computed tomography	4	If magnetic resonance angiography, computed tomography angiography, or

		ultrasound positive--potential value.
Positron emission tomography	2	
Appropriateness Criteria Scale 1 2 3 4 5 6 7 8 9 1=Least appropriate 9=Most appropriate		

* The choice of magnetic resonance angiography versus computed tomography angiography is dependent on local equipment and expertise.

The choice of single-photon emission computed tomography versus computed tomography versus magnetic resonance imaging for determining perfusion is dependent on local equipment and expertise. Major advances in potential applications are expected.

Clinical Condition: Transient Ischemic Attack*

Variant 3: Vertebrobasilar transient ischemic attack, initial screening survey.

Radiologic Exam Procedure	Appropriateness Rating	Comments
Ultrasound	5	
Intra-arterial angiography	4	If magnetic resonance angiography, computed tomography angiography, or ultrasound positive.
Magnetic resonance		
Magnetic resonance angiography	8	
Magnetic resonance plain (spin-echo gradient-echo, fluid-attenuated inversion recovery, and/or diffusion)	7	
Magnetic resonance with contrast	4	
Functional magnetic resonance imaging (BOLD, spectroscopy, and/or perfusion)	4	If magnetic resonance angiography, computed tomography angiography, or ultrasound positive--potential value.

Computed tomography		
Computed tomography angiography	6	
Computed tomography plain	4	
Computed tomography perfusion (xenon, iodine)	4	If magnetic resonance angiography, computed tomography angiography, or ultrasound positive--potential value.
Computed tomography with contrast	2	
Nuclear medicine		
Single-photon emission computed tomography	4	If magnetic resonance angiography, computed tomography angiography, or ultrasound positive--potential value.
Positron emission tomography	2	
Appropriateness Criteria Scale 1 2 3 4 5 6 7 8 9 1=Least appropriate 9=Most appropriate		

* The choice of magnetic resonance angiography versus computed tomography angiography is dependent on local equipment and expertise.

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Clinical Condition: Transient Ischemic Attack*

Variant 4: Carotid territory transient ischemic attack, documented occlusive disease (screen positive).

Radiologic Exam Procedure	Appropriateness Rating	Comments
Intra-arterial angiography	6	If surgery or endovascular intervention considered.
Ultrasound	4	

Magnetic resonance		
Magnetic resonance plain (spin-echo, gradient-echo, fluid-attenuated inversion recovery, and/or diffusion)	8	
Magnetic resonance angiography	8	
Functional magnetic resonance imaging (BOLD, spectroscopy, and/or perfusion)	5	
Magnetic resonance with contrast	4	
Computed tomography		
Computed tomography angiography	6	
Computed tomography perfusion (xenon, iodine)	5	
Computed tomography with contrast	4	
Computed tomography plain	4	
Nuclear medicine		
Single-photon emission computed tomography	5	
Positron emission tomography	2	
Appropriateness Criteria Scale 1 2 3 4 5 6 7 8 9 1=Least appropriate 9=Most appropriate		

* The choice of magnetic resonance angiography versus computed tomography angiography is dependent on local equipment and expertise.

The choice of single-photon emission computed tomography versus computed tomography versus magnetic resonance imaging for determining perfusion is dependent on local equipment and expertise. Major advances in potential applications are expected.

Clinical Condition: Transient Ischemic Attack*

Variant 5: Vertebrobasilar transient ischemic attack, documented occlusive disease (screen positive).

Radiologic Exam Procedure	Appropriateness Rating	Comments
Intra-arterial angiography	6	If surgery or endovascular intervention considered.
Ultrasound	4	
Magnetic resonance		
Magnetic resonance plain (spin-echo, gradient-echo, fluid-attenuated inversion recovery, and/or diffusion)	8	
Magnetic resonance angiography	8	
Magnetic resonance with contrast	4	
Functional magnetic resonance imaging (BOLD, spectroscopy, and/or perfusion)	4	
Computed tomography		
Computed tomography angiography	5	
Computed tomography plain	4	
Computed tomography with contrast	4	
Computed tomography perfusion	4	
Nuclear medicine		
Single-photon emission computed tomography	4	
Positron emission tomography	2	
Appropriateness Criteria Scale 1 2 3 4 5 6 7 8 9 1=Least appropriate 9=Most appropriate		

* The choice of magnetic resonance angiography versus computed tomography angiography is dependent on local equipment and expertise.

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Clinical Condition: Cerebrovascular Disease*

Variant 6: New focal neurologic defect, fixed or worsening. Less than 6 hours.

Radiologic Exam Procedure	Appropriateness Rating	Comments
Intra-arterial angiography	8	
Ultrasound	6	
Magnetic resonance		
Magnetic resonance plain (spin-echo, gradient-echo, fluid-attenuated inversion recovery, and/or diffusion)	8	
Magnetic resonance angiography	8	
Magnetic resonance with contrast	6	
Functional magnetic resonance imaging (BOLD, spectroscopy, and/or perfusion)	5	
Computed tomography		
Computed tomography plain	8	
Computed tomography angiography	6	
Computed tomography perfusion (xenon, iodine)	5	
Computed tomography with contrast	4	
Nuclear medicine		
Single-photon emission computed tomography	5	
Positron emission tomography	2	
Appropriateness Criteria Scale 1 2 3 4 5 6 7 8 9 1=Least appropriate 9=Most appropriate		

* The choice of magnetic resonance angiography versus computed tomography angiography is dependent on local equipment and expertise.

The choice of single-photon emission computed tomography versus computed tomography versus magnetic resonance imaging for determining perfusion is dependent on local equipment and expertise. Major advances in potential applications are expected.

Clinical Condition: Cerebrovascular Disease*

Variant 7: New focal neurologic defect, fixed or worsening. Six to 24 hours.

Radiologic Exam Procedure	Appropriateness Rating	Comments
Ultrasound	6	
Intra-arterial angiography	5	If therapy considered.
Magnetic resonance		
Magnetic resonance plain (spin-echo, gradient-echo, fluid-attenuated inversion recovery, and/or diffusion)	8	
Magnetic resonance angiography	8	
Magnetic resonance with contrast	6	
Functional magnetic resonance imaging (BOLD, spectroscopy, and/or perfusion)	5	
Computed tomography		
Computed tomography plain	8	
Computed tomography angiography	6	
Computed tomography perfusion (xenon, iodine)	5	
Computed tomography with contrast	4	
Nuclear medicine		
Single-photon emission computed tomography	5	
Positron emission tomography	2	
Appropriateness Criteria Scale 1 2 3 4 5 6 7 8 9		

1=Least appropriate 9=Most appropriate

* The choice of magnetic resonance angiography versus computed tomography angiography is dependent on local equipment and expertise.

The choice of single-photon emission computed tomography versus computed tomography versus magnetic resonance imaging for determining perfusion is dependent on local equipment and expertise. Major advances in potential applications are expected.

Clinical Condition: Cerebrovascular Disease*

Variant 8: New focal neurologic defect, fixed or worsening. Greater than 24 hours.

Radiologic Exam Procedure	Appropriateness Rating	Comments
Ultrasound	6	
Intra-arterial angiography	4	
Magnetic resonance		
Magnetic resonance plain (spin-echo, gradient-echo, fluid-attenuated inversion recovery, and/or diffusion)	8	
Magnetic resonance angiography	8	
Magnetic resonance with contrast	4	
Functional magnetic resonance imaging (BOLD, spectroscopy, and/or perfusion)	4	
Computed tomography		
Computed tomography plain	8	
Computed tomography angiography	6	
Computed tomography with contrast	4	If neoplasm in differential.
Computed tomography perfusion (xenon, iodine)	4	
Nuclear medicine		
Single-photon emission computed tomography	4	

Positron emission tomography	2	
Appropriateness Criteria Scale 1 2 3 4 5 6 7 8 9 1=Least appropriate 9=Most appropriate		

* The choice of magnetic resonance angiography versus computed tomography angiography is dependent on local equipment and expertise.

The choice of single-photon emission computed tomography versus computed tomography versus magnetic resonance imaging for determining perfusion is dependent on local equipment and expertise. Major advances in potential applications are expected.

Clinical Condition: Subarachnoid Hemorrhage*

Variant 9: Clinically suspected hemorrhage.

Radiologic Exam Procedure	Appropriateness Rating	Comments
Intra-arterial angiography	8	
Ultrasound	2	
Magnetic resonance		
Magnetic resonance angiography	7	Either magnetic resonance angiography or computed tomography angiography--if conventional angiography not already done.
Magnetic resonance plain (spin-echo, gradient-echo, fluid-attenuated inversion recovery, and/or diffusion)	5	
Magnetic resonance with contrast	4	
Functional magnetic resonance imaging (BOLD, spectroscopy, and/or perfusion)	2	
Computed tomography		
Computed tomography plain	9	
Computed tomography angiography	7	Either magnetic resonance

		angiography or computed tomography angiography--if conventional angiography not already done.
Computed tomography with contrast	4	
Computed tomography perfusion (xenon, iodine)	4	
Nuclear medicine		
Single-photon emission computed tomography	2	
Positron emission tomography	2	
Appropriateness Criteria Scale 1 2 3 4 5 6 7 8 9 1=Least appropriate 9=Most appropriate		

* The choice of magnetic resonance angiography versus computed tomography angiography is dependent on local equipment and expertise.

The choice of single-photon emission computed tomography versus computed tomography versus magnetic resonance imaging for determining perfusion is dependent on local equipment and expertise. Major advances in potential applications are expected.

Clinical Condition: Subarachnoid Hemorrhage*

Variant 10: Proven subarachnoid hemorrhage by lumbar puncture or imaging.

Radiologic Exam Procedure	Appropriateness Rating	Comments
Intra-arterial angiography	8	
Ultrasound	2	
Magnetic resonance		
Magnetic resonance angiography	6	Either magnetic resonance angiography or computed tomography angiography--if conventional angiography not already

		done.
Magnetic resonance plain (spin-echo, gradient-echo, fluid-attenuated inversion recovery, and/or diffusion)	5	
Magnetic resonance with contrast	4	
Functional magnetic resonance imaging (BOLD, spectroscopy, and/or perfusion)	2	
Computed tomography		
Computed tomography plain	8	For follow-up.
Computed tomography angiography	6	Either magnetic resonance angiography or computed tomography angiography--if conventional angiography not already done.
Computed tomography with contrast	3	
Computed tomography perfusion (xenon, iodine)	2	
Nuclear medicine		
Single-photon emission computed tomography	2	
Positron emission tomography	2	
Appropriateness Criteria Scale 1 2 3 4 5 6 7 8 9 1=Least appropriate 9=Most appropriate		

* The choice of magnetic resonance angiography versus computed tomography angiography is dependent on local equipment and expertise.

The choice of single-photon emission computed tomography versus computed tomography versus magnetic resonance imaging for determining perfusion is dependent on local equipment and expertise. Major advances in potential applications are expected.

Clinical Condition: Subarachnoid emorrhage*

Variant 11: Proven subarachnoid hemorrhage, negative angiogram.

Radiologic Exam Procedure	Appropriateness Rating	Comments
Intra-arterial angiography	8	Usually wait greater than 1 week for follow-up angiography.
Ultrasound	2	
Magnetic resonance		
Magnetic resonance plain (spin-echo, gradient-echo, fluid-attenuated inversion recovery, and/or diffusion)	8	
Magnetic resonance angiography	7	
Functional magnetic resonance imaging (BOLD, spectroscopy, and/or perfusion)	4	
Magnetic resonance with contrast	2	
Computed tomography		
Computed tomography angiography	7	
Computed tomography plain	6	For follow-up.
Computed tomography perfusion (xenon, iodine)	4	
Computed tomography with contrast	3	
Nuclear medicine		
Single-photon emission computed tomography	4	
Positron emission tomography	2	
Appropriateness Criteria Scale 1 2 3 4 5 6 7 8 9 1=Least appropriate 9=Most appropriate		

* The choice of magnetic resonance angiography versus computed tomography angiography is dependent on local equipment and expertise.

The choice of single-photon emission computed tomography versus computed tomography versus magnetic resonance imaging for determining perfusion is dependent on local equipment and expertise. Major advances in potential applications are expected.

Clinical Condition: Parenchymal Hemorrhage*

Variant 12: Suspected hemorrhage (hematoma).

Radiologic Exam Procedure	Appropriateness Rating	Comments
Intra-arterial Angiography	6	
Ultrasound	2	
Magnetic resonance		
Magnetic resonance plain (spin-echo, gradient-echo, fluid-attenuated inversion recovery, and/or diffusion)	8	
Magnetic resonance angiography	6	Either magnetic resonance angiography or computed tomography angiography – if conventional angiography not already done.
Magnetic resonance with contrast	5	
Functional magnetic resonance imaging (BOLD, spectroscopy, and/or perfusion)	3	
Computed tomography		
Computed tomography plain	8	
Computed tomography with contrast	6	
Computed tomography angiography	6	Either magnetic resonance angiography or computed tomography angiography – if conventional angiography not already done.
Computed tomography perfusion (xenon, iodine)	3	
Nuclear medicine		

Single-photon emission computed tomography	3	
Positron emission tomography	2	
Appropriateness Criteria Scale 1 2 3 4 5 6 7 8 9 1=Least appropriate 9=Most appropriate		

* The choice of magnetic resonance angiography versus computed tomography angiography is dependent on local equipment and expertise.

The choice of single-photon emission computed tomography versus computed tomography versus magnetic resonance imaging for determining perfusion is dependent on local equipment and expertise. Major advances in potential applications are expected.

Clinical Condition: Parenchymal Hemorrhage*

Variant 13: Proven hemorrhage (hematoma)

Radiologic Exam Procedure	Appropriateness Rating	Comments
Intra-arterial angiography	6	
Ultrasound	2	
Magnetic resonance		
Magnetic resonance plain (spin-echo, gradient-echo, fluid-attenuated inversion recovery, and/or diffusion)	8	
Magnetic resonance with contrast	6	
Magnetic resonance angiography	6	Either magnetic resonance angiography or computed tomography angiography--if conventional angiography not already done.
Functional magnetic resonance imaging (BOLD, spectroscopy, and/or perfusion)	3	
Computed tomography		

Computed tomography plain	6	
Computed tomography angiography	6	Either magnetic resonance angiography or computed tomography angiography--if conventional angiography not already done.
Computed tomography with contrast	5	If contrast magnetic resonance not available.
Computed tomography perfusion (xenon, iodine)	3	
Nuclear medicine		
Single-photon emission computed tomography	3	
Positron emission tomography	2	
Appropriateness Criteria Scale 1 2 3 4 5 6 7 8 9 1=Least appropriate 9=Most appropriate		

* The choice of magnetic resonance angiography versus computed tomography angiography is dependent on local equipment and expertise.

The choice of single-photon emission computed tomography versus computed tomography versus magnetic resonance imaging for determining perfusion is dependent on local equipment and expertise. Major advances in potential applications are expected.

Clinical Condition: Risk for Unruptured Aneurysm*

Variant 14: Positive family history.

Radiologic Exam Procedure	Appropriateness Rating	Comments
Intra-arterial angiography	4	
Ultrasound	2	
Magnetic resonance		
Magnetic resonance angiography	7	
Magnetic resonance plain	6	

(spin-echo, gradient-echo, fluid-attenuated inversion recovery, and/or diffusion)		
Magnetic resonance with contrast	4	
Functional magnetic resonance imaging (BOLD, spectroscopy, and/or perfusion)	2	
Computed tomography		
Computed tomography angiography	6	If magnetic resonance angiography not available.
Computed tomography plain	4	
Computed tomography with contrast	2	
Computed tomography perfusion (xenon, iodine)	2	
Appropriateness Criteria Scale 1 2 3 4 5 6 7 8 9 1=Least appropriate 9=Most appropriate		

* The choice of magnetic resonance angiography versus computed tomography angiography is dependent on local equipment and expertise.

The choice of single-photon emission computed tomography versus computed tomography versus magnetic resonance imaging for determining perfusion is dependent on local equipment and expertise. Major advances in potential applications are expected.

Summary

Because of the gravity of stroke's sequelae, considerable effort has been expended to identify risk factors for cardiovascular disease (see Appendix A in the original guideline document) and strategies for stroke prevention in high-risk patients. These range from modification of lifestyle to surgical intervention; the latter has been shown effective in altering morbidity of both asymptomatic and symptomatic patients in randomized, prospective clinical trials in which the intent to treat was determined partly by imaging. In asymptomatic patients, screening should be undertaken not only by a sensitive, noninvasive (i.e., low-risk) test directed at identifying the abnormal cerebrovascular substrate but also with some consideration for identifying those in risk populations with a high prevalence of disease (e.g., patients with carotid bruit). Although the diagnostic accuracy of duplex ultrasound, computed tomography angiography, and magnetic resonance angiography are all high, only ultrasound appears to offer cost-effective screening. Alternatively, variability in performance (efficacy vs. effectiveness)

precludes endorsement of its routine use as the sole examination before endarterectomy. Similarly, a variety of imaging strategies exists, that may be undertaken in symptomatic cases where the initial examinations may be directed toward the brain parenchyma, and a vascular study may be included as an expeditious ancillary examination. It should be noted that although surgical outcome studies were based on catheter angiography, the possible morbidity of these studies and continuing improvement in noninvasive exams has made these studies less common.

Although the onset and severity of injury are typically assessed on the basis of clinical presentation, the distinctions between ischemic and hemorrhagic etiologies are determined on the basis of imaging. Rapid and successful diagnosis of hemorrhage, ischemia, and completed infarction have become paramount in importance to treatment of acute cerebrovascular disease because of the demonstrable benefit (and risk) of acute intravenous and intra-arterial thrombolytic therapy in prospective clinical trials. On this basis, the experimentally supported concept of the ischemic penumbra, i.e., the presence of dysfunctional yet viable halo of brain parenchyma about a region of ischemia, has gained clinical favor. Its primary impact has been to create a sense of urgency and accelerate cerebrovascular diagnoses and therapy to a relatively narrow time window after onset of ictus. For this reason, appropriateness of a diagnostic modality in the context of acute stroke must consider not only sensitivity and specificity to hemorrhage, ischemia and infarction but also availability.

With the introduction of computed tomography scanning by Hounsfield in the early 1970's came the ability to acutely assess the brain, subarachnoid, and ventricular spaces noninvasively. Similarly, on the basis of the x-ray attenuation of blood and edema relative to cerebrospinal fluid and brain parenchyma, computed tomography is effective in the detection of acute hemorrhage into brain parenchyma, the subarachnoid, subdural, or intraventricular spaces, and in distinguishing acute hemorrhage from ischemia/infarction. Computed tomography lacks a similar sensitivity to acute ischemia and infarction. Nevertheless, on the basis of ready availability and high sensitivity to the presence or absence of acute blood, computed tomography historically has been the preferred modality to initially direct ischemic stroke therapy.

Alternatively, magnetic resonance imaging in the form of diffusion-weighted scans has been shown exquisitely sensitive to acute infarction within minutes of the precipitating ictus. Additional information obtainable through the combined use of dynamic cerebral blood volume techniques (i.e., perfusion imaging) as well as vascular imaging (i.e., magnetic resonance angiography) makes magnetic resonance an appealing tool in the diagnosis and treatment of acute cerebrovascular disease. However, enthusiasm for magnetic resonance in the setting of acute stroke has often been stifled by the often variable and confounding appearance of hemorrhage on magnetic resonance. The recognition and characterization of the magnetic resonance findings in intracranial hemorrhage are understandable if one considers:

- the location, specifically subarachnoid vs. intraparenchymal;
- the oxidative state of hemoglobin and the subsequent breakdown products;
- the type of imaging pulse sequence used (T1 vs. T2, spin-echo vs. gradient-echo, conventional spin-echo vs. RARE sequences); and

- the field strength of the machine used to acquire the images.

Recent experience using T2* (gradient echo) imaging to detect parenchymal hemorrhage and fluid-attenuated inversion recovery scans to detect subarachnoid blood have helped to renew interest in magnetic resonance as a first-line modality in patients with acute, focal neurologic deficits. It is important to reemphasize the issue of availability of magnetic resonance in the context of the therapeutic window and potential contraindications to magnetic resonance: patients with pacemakers, cerebral aneurysm clips, ocular foreign bodies, cochlear implants, those suffering from claustrophobia, or morbid obesity (greater than 320 pounds).

As mentioned previously, computed tomography scanning is highly sensitive to the presence or absence of acute blood and has been the mainstay in emergent evaluation of acute cerebrovascular disease. Documented, acute subarachnoid or parenchymal hemorrhage are conditions associated with high morbidity and mortality. In the case of aneurysmal subarachnoid hemorrhage, this is partly due to the relatively high rate of early rebleeding. In patients presenting with low-grade subarachnoid hemorrhage, early surgery is offered as a strategy to circumvent this problem, which in turn early-plan cerebral angiography. Intra-arterial angiography's sensitivity to cerebral aneurysms is estimated to be greater than 90%; in the setting of acute subarachnoid hemorrhage this figure decreases to slightly greater than 80%. Initially negative studies may require additional angiography at a future time. The late appearance of new neurologic changes suggestive of post- subarachnoid hemorrhage vasospasm, ischemia, or hydrocephalus may be indications for transcranial Doppler, single photon emission computed tomography, angiography, and computed tomography scanning.

Because of the high morbidity and mortality of acute subarachnoid hemorrhage and the relative safety of clipping nonruptured intracranial aneurysms, there may be a clinical role for prophylactic screening. Intra-arterial angiography carries the risk of thromboembolic complication and is relatively expensive; magnetic resonance angiography or computed tomography angiography provides a less expensive, noninvasive alternative, although the sensitivity to lesions less than 5 mm in diameter is suspect. To date, individuals with a history of aneurysm or subarachnoid hemorrhage in a first-degree relative have been considered candidates for screening. Nevertheless, significant gaps in knowledge of the natural history (and thus risk of rupture) of intracranial aneurysms remain. Hence, while screening with magnetic resonance angiography may be appropriate in patients with a positive family history, its impact on patient outcome is questionable.

Parenchymal brain hemorrhage may be associated with underlying vascular malformations such as pial arteriovenous fistulae and cavernous malformations in younger patients as well as dural fistulae in older individuals. Diagnosis, assessment of risk for future hemorrhage, and effective treatment planning are all predicated on determination of size of the underlying lesion, location within the brain parenchyma, pattern of venous drainage, and presence of intranidal aneurysm. Acutely, this information is most frequently obtained by intra-arterial angiography, which in more complicated cases may be supplemented by magnetic resonance scanning. Baseline and follow-up magnetic resonance scans may be particularly appropriate in partially treated cases or in patients undergoing stereotactic radiosurgery as a noninvasive, low risk means of following therapy.

CLINICAL ALGORITHM(S)

Algorithms were not developed from criteria guidelines.

EVIDENCE SUPPORTING THE RECOMMENDATIONS

TYPE OF EVIDENCE SUPPORTING THE RECOMMENDATIONS

The recommendations are based on analysis of the current literature and expert panel consensus.

BENEFITS/HARMS OF IMPLEMENTING THE GUIDELINE RECOMMENDATIONS

POTENTIAL BENEFITS

Appropriate selection of radiologic exam procedures to diagnose acute cerebrovascular disease to allow for quick treatment because of the demonstrable benefit (and risk) of acute intravenous and intra-arterial thrombolytic therapy in prospective clinical trials.

POTENTIAL HARMS

Risks associated with thrombolytic therapy.

QUALIFYING STATEMENTS

QUALIFYING STATEMENTS

An American College of Radiology (ACR) Committee on Appropriateness Criteria and its expert panels have developed criteria for determining appropriate imaging examinations for diagnosis and treatment of specified medical condition(s). These criteria are intended to guide radiologists, radiation oncologists and referring physicians in making decisions regarding radiologic imaging and treatment. Generally, the complexity and severity of a patient's clinical condition should dictate the selection of appropriate imaging procedures or treatments. Only those exams generally used for evaluation of the patient's condition are ranked. Other imaging studies necessary to evaluate other co-existent diseases or other medical consequences of this condition are not considered in this document. The availability of equipment or personnel may influence the selection of appropriate imaging procedures or treatments. Imaging techniques classified as investigational by the U.S. Food and Drug Administration (FDA) have not been considered in developing these criteria; however, study of new equipment and applications should be encouraged. The ultimate decision regarding the appropriateness of any specific radiologic examination or treatment must be made by the referring physician and radiologist in light of all the circumstances presented in an individual examination.

IMPLEMENTATION OF THE GUIDELINE

DESCRIPTION OF IMPLEMENTATION STRATEGY

An implementation strategy was not provided.

INSTITUTE OF MEDICINE (IOM) NATIONAL HEALTHCARE QUALITY REPORT CATEGORIES

IOM CARE NEED

Living with Illness

IOM DOMAIN

Effectiveness

IDENTIFYING INFORMATION AND AVAILABILITY

BIBLIOGRAPHIC SOURCE(S)

Masaryk T, Drayer BP, Anderson RE, Braffman B, Davis PC, Deck MD, Hasso AN, Johnson BA, Pomeranz SJ, Seidenwurm D, Tanenbaum L, Masdeu JC. Cerebrovascular disease. American College of Radiology. ACR Appropriateness Criteria. Radiology 2000 Jun;215(Suppl):415-35. [60 references]

ADAPTATION

Not applicable: The guideline was not adapted from another source.

DATE RELEASED

1996 (revised 2000)

GUIDELINE DEVELOPER(S)

American College of Radiology - Medical Specialty Society

SOURCE(S) OF FUNDING

The American College of Radiology (ACR) provided the funding and the resources for these ACR Appropriateness Criteria™.

GUIDELINE COMMITTEE

ACR Appropriateness Criteria™ Committee, Expert Panel on Neurologic Imaging

COMPOSITION OF GROUP THAT AUTHORED THE GUIDELINE

Names of Panel Members: Thomas Masaryk, MD; Burton P. Drayer, MD; Robert E. Anderson, MD; Bruce Braffman, MD; Patricia C. Davis, MD; Michael D. F. Deck, MD; Anton N. Hasso, MD; Blake A. Johnson, MD; Stephen J. Pomeranz, MD; David Seidenwurm, MD; Lawrence Tanenbaum, MD; Joseph C. Masdeu, MD, PhD

FINANCIAL DISCLOSURES/CONFLICTS OF INTEREST

Not stated

GUIDELINE STATUS

This is the current release of the guideline. It is a revision of a previously issued version (Appropriateness criteria for cerebrovascular disease. Reston [VA]: American College of Radiology [ACR]; 1996. 21 p. [ACR Appropriateness Criteria™]).

The ACR Appropriateness Criteria™ are reviewed after five years, if not sooner, depending upon introduction of new and highly significant scientific evidence. The next review date for this topic is 2005.

GUIDELINE AVAILABILITY

Electronic copies: Available from the American College of Radiology (ACR) Web site.

Print copies: Available from ACR, 1891 Preston White Drive, Reston, VA 20191. Telephone: (703) 648-8900.

AVAILABILITY OF COMPANION DOCUMENTS

None available

PATIENT RESOURCES

None available

NGC STATUS

This summary was completed by ECRI on July 31, 2001. The information was verified by the guideline developer as of August 24, 2001.

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